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Standard Test Methods for Elastic Properties of Textile Fibers¹

This standard is issued under the fixed designation D 1774; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 These test methods cover measurement of the elastic behavior of fibers by assessing their ability to recover strain-induced energy, and to recover their original dimensions following a known extension. Since the crimp in a fiber alters the initial shape of the stress-strain curve, separate procedures are described for uncrimped and crimped fibers.

NOTE 1—For the determination of the elastic properties of elastomeric yarns, refer to Test Method D 2731, Test Method for Elastic Properties of Elastomeric Yarns (Constant-Rate-of-Extension Machines).²

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- D 76 Specification for Tensile Testing Machines for Textiles²
- D 123 Terminology Relating to Textiles²
- D 1776 Practice for Conditioning Textiles for Testing²
- D 2258 Practice for Sampling Yarn for Testing²
- D 3333 Practice for Sampling Man-Made Staple Fibers, Sliver, or Tow for Testing³
- D 4848 Terminology of Force, Deformation and Related Properties of Textiles³

3. Terminology

3.1 Definitions:

3.1.1 *deformation, permanent, n*—the net long-term change in a dimension of a specimen after deformation and relaxation under specified conditions. (*Syn.* permanent set, nonrecoverable deformation, and nonrecoverable stretch.)

3.1.1.1 *Discussion*—Permanent deformation is usually expressed as a percentage of the original dimension.

3.1.2 *elongation, n*—the ratio of the extension of a material to the length of the material prior to stretching, expressed as a percent.

3.1.2.1 *Discussion*—Elongation may be measured at any specified force or at rupture.

3.1.3 *tensile strain recovery, n*—the percent of recoverable

extension to the total extension impressed on a fiber under specified conditions.

3.1.3.1 *Discussion*—The tensile strain recovery includes both immediate elastic recovery and delayed recovery and is equivalent to the quantity 100 – percent permanent deformation.

3.1.4 *work recovery, n*—the percent of recoverable work to the total work required to strain a fiber a specified amount under specified conditions.

3.1.5 For definitions of other terms related to force and deformation in textiles, refer to Terminology D 4848. For definitions of other textile terms used in this test method, refer to Terminology D 123.

4. Summary of Test Methods

4.1 The elastic properties of fibers are measured by (1) determining the amount of recoverable energy exhibited by a fiber when it is stretched to a predetermined extension at a specific rate of strain, held at this extension for a specified length of time, and finally relaxed at the same rate at which it was extended; and (2) determining the dimensional recovery of the fiber following the strain history described in Item (1).

5. Significance and Use

5.1 Elastic properties are related to a fiber's ability to recover from a tensile deformation. These properties are important in the selection of fibers for specific end-use application and in determining processing characteristics.

5.2 This test method specifies that the fiber is to be tested at each of three levels of extension (2.0 %, 5.0 %, and 10.0 %) to describe the elastic behavior of the fiber at both small and large deformations.

5.3 This method of testing the elastic properties of fibers is not recommended for acceptance testing of commercial shipments of fibers because the between-laboratory precision has not been established. In some cases the purchaser and the seller may have to test a commercial shipment of one or more specific materials by the best available method, even though the method has not been recommended for acceptance testing of commercial shipments. In such a case, if there is a disagreement arising from differences in values reported by the purchaser and the seller when using this test method for acceptance testing, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the seller should be determined with each comparison being based on testing specimens randomly drawn from one sample of material of the type being evaluated.

6. Apparatus

6.1 *Constant-Rate-of-Specimen-Extension- (CRE) Type Tensile Testing Machine*, conforming to 5.1.1 and 6.1

¹ These test methods are under the jurisdiction of ASTM Committee D-13 on Textiles and are the direct responsibility of Subcommittee D13.57 on Fiber Test Methods, General.

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² *Annual Book of ASTM Standards*, Vol 07.01.

³ *Annual Book of ASTM Standards*, Vol 07.02.